

1. An apparatus for electroplating a semiconductor product, said apparatus comprising:

a support device for supporting the semiconductor product in an electroplating solution;

5 an electrical circuit for applying an electrical potential across the electroplating solution, said electrical circuit including an electrode;

a control device for changing the distance between the semiconductor product and said electrode after an initial amount of material is electroplated on the semiconductor product.

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2. The apparatus of claim 1, wherein said control device includes a mechanism for moving said electrode toward the semiconductor product.

3. The apparatus of claim 1, wherein said control device includes  
15 a mechanism for moving the semiconductor product toward said electrode.

4. The apparatus of claim 1, further comprising a processor for operating said control device in response to input data correlated to the electroplating process.

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5. The apparatus of claim 4, wherein said input data represents elapsed time.

6. The apparatus of claim 4, wherein said input data includes bath  
25 resistance.

7. The apparatus of claim 4, wherein said input data represents the resistance of the semiconductor product.

8. The apparatus of claim 4, wherein said input data represents an optical characteristic of the semiconductor product.

9. The apparatus of claim 4, wherein said input data represents the surface capacitance of the semiconductor product.

10. A method of electroplating a surface of a semiconductor wafer, said method comprising the steps of:

10 locating said surface of said semiconductor wafer in an electroplating solution;  
using an electrode to electroplate an initial amount of material on said surface of said semiconductor wafer;  
subsequently, reducing the distance between said electrode and said surface of said semiconductor wafer; and  
15 subsequently, using said electrode to electroplate an additional amount of material on said surface of said semiconductor wafer.

11. The method of claim 10, further comprising the step of providing a seed layer on said semiconductor wafer.

20 12. The method of claim 11, further comprising the step of supporting said wafer in said electroplating solution.

13. The method of claim 12, wherein the step of reducing the distance between said electrode and said wafer surface includes the step of moving said electrode toward said semiconductor wafer.

14. The method of claim 12, wherein the step of reducing the distance between said electrode and said wafer surface includes the step of moving said semiconductor wafer toward said electrode.

5           15. The method of claim 12, further comprising the step of agitating said electroplating solution in the vicinity of said semiconductor wafer surface.

10           16. The method of claim 12, wherein said electroplating solution contains copper.

17. The method of claim 12, wherein said electroplating solution contains platinum.

15           18. The method of claim 12, wherein said electroplating solution contains gold.

20           19. The method of claim 12, wherein said step of reducing the distance between said electrode and said semiconductor wafer surface occurs in response to elapsed time.

25           20. The method of claim 12, wherein said step of reducing the distance between said electrode and said surface occurs in response to measured characteristics.

21. A method of electroplating a semiconductor workpiece, said method comprising the steps of:  
providing a seed layer on said workpiece;

causing a first electrical current to flow through a first length of electroplating solution to electroplate an initial amount of metal on said seed layer; and

5 causing a second electrical current to flow through a second length of said electroplating solution to electroplate an additional amount of metal on said initial amount of metal, said second length being less than said first length.

10 22. The method of claim 21, further comprising the step of removing said workpiece from said electroplating solution.

15 23. The method of claim 22, wherein said currents are applied through contacts, and wherein said contacts are used to support said workpiece in said electroplating solution.

24. The method of claim 23, further comprising the step of using an electrode in said electroplating solution.

20 25. The method of claim 24, further comprising the step of moving said electrode toward said semiconductor workpiece.

25 26. The method of claim 25, wherein said moving step occurs subsequent to said step of causing said first electrical current to flow through said electroplating solution.

27. The method of claim 26, wherein said moving step occurs responsive to a measured parameter.

28. The method of claim 27, wherein said measured parameter is elapsed time.

29. The method of claim 27, wherein said measured parameter  
5 includes an optical characteristic of said workpiece.

30. The method of claim 26, wherein said moving step occurs responsive to a signal representative of electroplated material on said workpiece.

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31. The method of claim 30, further comprising the step of measuring an electrical characteristic of said workpiece.

32. A method of operating an electroplating apparatus, said  
15 method comprising the steps of:  
locating a semiconductor product in an electroplating solution;  
generating a signal correlated to metal electroplated on said semiconductor product; and

in response to said signal, changing the length through which  
20 electrical current flows through said electroplating solution.

33. The method of claim 32, further comprising the step of monitoring at least one parameter representative of the metal electroplated on said product.

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34. The method of claim 33, wherein said parameter is time.

35. The method of claim 33, wherein said parameter is electrical resistance.

36. The method of claim 33, wherein said parameter is an optical characteristic of said product.

37. The method of claim 33, wherein said parameter is the  
5 surface capacitance of said product.

38. The method of claim 33, further comprising the step of measuring the electrical resistance of said product.

10 39. The method of claim 38, wherein said parameter is the electrical resistance of said semiconductor product.

40. The method of claim 39, wherein said semiconductor product includes at least one integrated circuit.

15 41. The method of claim 40, further comprising the step of providing a refractory seed layer on said semiconductor product.

42. The method of claim 41, further comprising the step of  
20 agitating said electroplating solution.

43. The method of claim 42, wherein said electroplating solution contains copper.

25 44. The method of claim 42, wherein said electroplating solution contains platinum.

45. The method of claim 42, wherein said electroplating solution contains gold.

46. A method of operating an electroplating apparatus, said method comprising the steps of:

locating a semiconductor product in an electroplating solution;

while said product is located in said electroplating solution,

5 generating a signal correlated to the resistance of said semiconductor product; and

in response to said signal, changing the length through which electrical current flows through said electroplating solution.

10 47. The method of claim 46, further comprising the step of changing the voltage applied through said electroplating solution.

48. The method of claim 46, further comprising the step of changing the amount of current flowing through said electroplating  
15 solution.

49. The method of claim 46, wherein said length is changed in a step-wise manner.

20 50. The method of claim 46, wherein said length is changed continuously.